In the Claims

Current Status of Claims

1.(canceled)

2.(canceled)

3.(canceled)

4.(canceled)

5.(canceled)

6.(canceled)

7.(canceled)

8.(canceled)

9.(canceled)

10.**(previously presented)** An analytical instrument including an excitation source for producing an incident waveform, a detector for receiving either a transmission spectrum or a reflectance spectrum or both a transmission spectrum and a reflectance spectrum of an object or volume of interest, and a processing unit for analyzing the spectra, where the processing unit includes software encoding the inverse scattering method of Claims 14, 15, 16, 17, 18, 19, 20, or 21.

11.**(previously presented)** A sonic analytical instrument including a sonic excitation source for producing an incident sonic waveform, a detector for receiving either a sonic transmission spectrum or a sonic reflectance spectrum or both a sonic transmission spectrum and a sonic reflectance spectrum of an object or volume of interest, and a processing unit for analyzing the sonic spectra, where the processing unit includes software encoding the inverse scattering method of Claims 14, 15, 16, 17, 18, 19, 20, or 21.

12.**(previously presented)** An electromagnetic analytical instrument including an electromagnetic excitation source for producing an incident electromagnetic waveform, a detector for receiving either an electromagnetic transmission spectrum or an electromagnetic reflectance spectrum or both an electromagnetic transmission spectrum and an electromagnetic reflectance spectrum of an object or volume of interest, and a processing unit for analyzing the electromagnetic spectra, where the processing unit includes software encoding the inverse scattering method of claims 14, 15, 16, 17, 18, 19, 20, or 21.

13.(previously presented) An analytical instrument including a sonic excitation source and an electromagnetic excitation source for producing an incident sonic waveform and an incident electromagnetic waveform, a detector for receiving either a sonic transmission spectrum or a sonic reflectance spectrum or both a sonic transmission spectrum and a sonic reflectance spectrum of an object or volume of interest, a detector for receiving either an electromagnetic transmission spectrum or an electromagnetic reflectance spectrum or both an electromagnetic transmission spectrum and an electromagnetic reflectance spectrum of an object or volume of interest, and a processing unit for analyzing the sonic and electromagnetic spectra, where the processing unit includes software encoding the inverse scattering method of Claims 14, 15, 16, 17, 18, 19, 20, or 21.

14.(previously presented) A method for analyzing inverse scattering spectral components comprising the steps of:

irradiating an object with a measuring wave;

measuring a reflection spectrum of the object;

measuring a transmission spectrum of the object;

calculating a transmission coefficient on a computer from:

$$t_k = 1 - \frac{ik}{2}\int_{-\infty}^{+\infty} dz e^{ikz} V(z)\psi_k^+(z),$$

where $V(z)$ is the location interaction between the object and $\psi_k^+(z)$ is the measuring wave,

calculating a reflection coefficient on the computer from:

$$r_k = -\frac{ik}{2}\int_{-\infty}^{-\infty} e^{-ikz} V(z)\psi_k^+(z)$$

using a set of definitions

$$t_k \tilde{\psi}_k(z) = \psi_k^+(z)$$

$$\frac{r_k}{t_k} = \tilde{r}_k$$

$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k)\frac{2i}{k}\tilde{r}_k e^{-2ikz}$$

to convert a Lippmann-Schwinger inverse scattering equation

$$\psi_k^+(z) = e^{ikz} - \frac{ik}{2}\int_{-\infty}^{+\infty} dz' e^{ik|z-z'|} V(z')\psi_k^+(z')$$

on the computer into a Volterra-type form

$$\widetilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k) e^{-2ikz} \frac{2i}{k} r_k \left[1 + \frac{ik}{2}\int_{-\infty}^{+\infty} e^{-ikz} V(z_j)\widetilde{\psi}_k(z)\right]; \text{ and}$$

iterating the Volterra-type form of the Lippman-Schwinger equation on the computer to produce an approximate solution $\widetilde{V}_1(z)$, where $\widetilde{V}_1(z)$ is absolutely and uniformly convergent.

15.**(currently amended)** The method of claim 14, wherein the approximate solution ~~includes~~ $\widetilde{V}_1(z)$ includes four terms.

16.**(currently amended)** The method of claim 14, wherein the approximate solution ~~includes~~ $\widetilde{V}_1(z)$ includes three terms.

17.**(currently amended)** The method of claim 14, wherein the approximate solution ~~includes~~ $\widetilde{V}_1(z)$ includes two terms.

18.**(previously presented)** A method for analyzing inverse scattering components of a spectrum of an object of interest comprising the steps of:

obtaining a reflectance and/or transmission spectra of an object of interest using an incident waveform from the group consisting of an electromagnetic waveform, sonic waveform and mixtures or combinations thereof;

calculating a transmission coefficient on a computer from:

$$t_k = 1 - \frac{ik}{2}\int_{-\infty}^{+\infty} dz e^{ikz} V(z)\psi_k^+(z),$$

where $V(z)$ is the location interaction between the object and $\psi_k^+(z)$ is the measuring wave,

calculating a reflection coefficient on the computer from:

$$r_k = -\frac{ik}{2}\int_{-\infty}^{+\infty} e^{-ikz} V(z)\psi_k^+(z)$$

using a set of definitions

$$t_k \tilde{\psi}_k(z) = \psi_k^+(z)$$

$$\frac{r_k}{t_k} = \tilde{r}_k$$

$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k)\frac{2i}{k}\tilde{r}_k e^{-2ikz}$$

to convert a Lippmann-Schwinger inverse scattering equation

$$\psi_k^+(z) = e^{ikz} - \frac{ik}{2}\int_{-\infty}^{+\infty} dz' e^{ik|z-z'|} V(z')\psi_k^+(z')$$

on the computer into a Volterra-type form

$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k) e^{-2ikz}\frac{2i}{k} r_k\left[1 + \frac{ik}{2}\int_{-\infty}^{+\infty} e^{-ikz} V(z_j)\tilde{\psi}_k(z)\right]; \text{ and}$$

iterating the Volterra-type form of the Lippman-Schwinger equation on the computer to produce $\tilde{V}_1(z)$, where $\tilde{V}_1(z)$ is absolutely and uniformly convergent.

19.**(currently amended)** The method of claim 18, wherein the approximate solution ~~includes~~ $\tilde{V}_1(z)$ includes four terms.

20.**(currently amended)** The method of claim 18, wherein the approximate solution ~~includes~~ $\tilde{V}_1(z)$ includes three terms.

21.**(currently amended)** The method of claim 18, wherein the approximate solution ~~includes~~ $\tilde{V}_1(z)$ includes two terms.